in the Exe and in the canal near Exeter, throughout the summer months; but, by attaching itself to plants which die down in the autumn, the specimens are all swept away by the winter floods.

XXXIII.—*On the* Spongiæ ciliatæ *as* Infusoria flagellata; *or Observations on the Structure, Animality, and Relationship of* Leucosolenia botryoides, *Bowerbank.* By H. James-Clark, A.B., B.S., Professor of Natural History in the Agricultural College of Pennsylvania.

[Continued from p. 215.]

§ 12. *Astasia trichophora*, Clap. Pl. VI. figs. 45, 46.

The transition from the mononematous *Monas*, *Codosiga*, *Leucosolenia*, &c. to those heteronematous Flagellata which possess at the same time a proboscidiform and a gubernacliform flagellum is most aptly exemplified by that curious mimetic combination of *Amœba* and *Anisonema* known as *Astasia trichophora*, Clap. (*Trachelius trichophorus*, Ehr.). At first sight it appears to be capable of all the abrupt retrogressive motions and short turnings of an *Anisonema* (figs. 65–69), without being endowed with a similar means of locomotion. One is not long, however, in discovering the homologue of the *trail* (*fl*²) or rudder (*gubernaclum*) of the latter in the posterior abdominal, triangular prolongation (fig. 45, *fl*²) of the body of the former. That this is the true interpretation of the prolongation is warranted not only by the use to which it is put, as a sort of *point d'appui* during the amœboid retroversions of the body, but also by its persistent form whilst the animal is contorted into a shapeless writhing mass. In the midst of the paucity of distinctive topography, we are also furnished by this organ, if I may so call it, with a basis of ready discrimination between the practically ventral and dorsal sides of the body; for, although it may not lie strictly in the central line of progress during reptation (nor could we expect to find it there upon being referred to its homological relation to the asymmetrically attached *gubernaclum* of *Anisonema*), it none the less belongs to the reptant side of the animal, and, as it were, controls its motions and acts as a keel, upon which the posterior end of the body vibrates and reels from side to side. Finally, in reference to this point, it may be added that this species does not swim, properly speaking, nor has it the character of the revolving natant forms, such as Dujardin separated from the *Astasia* of Ehrenberg and described under the name of *Peranema*.

For the sake of accumulating and multiplying diagnostic characters that shall serve us hereafter as discriminative points in determining the classificatory relations of Flagellata, it is most desirable that every critical study of one of these forms should be carefully recorded, even to the minutest details. On this account, therefore, and particularly in the present connexion, notwithstanding that this species is so frequently met with, and apparently so well known, it will not be out of place here to describe it anew, especially as some of the features presented for the consideration of naturalists are not in accordance with the interpretation put upon them by previous observers.

The *body* of this animalcule is colourless, but frequently has a slight yellowish or reddish tinge, which is derived by diffusion from the granular contents of the interior. The only legitimate colour present lies in the very faint red eye-spot (*s*). The form is variable, from elongate-ovate to cylindrical, with a gentle taper at the anterior third into a narrow truncate-emarginate head. Posteriorly the dorsal region is rounded; but on the ventral face a broad triangular prolongation (*fl*^{2}), already spoken of as the homologue of the *gubernaclum* of the reptant Heteronemata, extends backward beyond the outline of the *dorsum*. The exact relation of this prolongation to the axis of the body is not to be determined beyond a doubt, because of the constantly shifting attitude of the animal: at one moment the *gubernaclum* (*fl*^{2}) is on the left, and then at the next instant it appears on the right of the mesial line, or follows for awhile between these two points, according as the body keels over more or less from one side to the other or balances itself in a median position. It appears most frequently, however, to be unilateral.

The amœboid contortions (fig. 46) of the body have already been mentioned; but I would add that this is only a resemblance, a mere suggestion, if one may use the term, of the mode of locomotion of *Amœba*; for it is not, as in the latter, an actual *flowing out* of a glairy mass into protean reptant processes, but an exceedingly variable *puckering*, and always accompanied by a longitudinal contraction of the body, the one being evidently necessary to the other. If I may carry out the niceness of distinction further, I should say that, whilst *Amœba* is contractile and plastic, *Astasia* is retractile and flexible.

The *flagellum* (*fl*) also, by its subterminal attachment to the head, carries out the typical plan of the reptant Heteronemata. It is based strictly on the ventral side of the front, descending from the latter with such an abrupt turn forward

that it appears, without close observation, to be a mere tapering prolongation of this region. Yet it is neither related to the body in the latter sense, nor an extension of it from any point of view, but is as strictly an appendage as any form of vibratile cilia*, and alike as incapable of contraction. It is so stout and thick that one need not be surprised to find Ehrenberg, in the absence of a knowledge of the structure of this animalcule, mistaking the scarcely tapering *flagellum* for the frontal prolongation of a *Trachelius*. Usually it is about half as long again as the body; but that of very large animals often greatly exceeds this proportion. Its mode of action, as a propulsive organ, is not like that most frequently exhibited by the *flagella* of the truly natant Flagellata; for whilst in the latter case the vibrations pass along the whole length of the *cilium*, in the former they are confined to its distal end; and, moreover, they seem to be different in character, since, instead of simply undulating in a more or less restricted plane, the *flagellum* twirls at the tip rather after the manner of a revolving helix.

This method of progression is singularly modified by a rhombic meniscoid species of *Cyclidium*, Duj. (non Ehr.), whose *flagellum* during reptation projects (from a deeply subterminal point of the convex side of the body) without flexure almost to its tip, and then simply bends with frequent and vigorous strokes in the form of a hook, which it applies sidewise against the surface over which the creature is passing, and drags it after it, tilted over on one of its flanks, in a hitching sidelong manner.

As a tactile organ, and for the purposes of prehension, the *flagellum* appears, by its great flexibility and vigorous action, to be eminently capable. Feeling about it with all the apparent expectation of finally meeting with something, the animalcule keeps its proboscis in a constant quiver, lashing it backward and forward in the meanwhile, or thrusting it along its flanks and then abruptly withdrawing it, very much after the manner of a *Lacrymaria*. When a particle of food is brought near the mouth (*m*), it is, as it were, coaxed into it by the light pulsations of the *flagellum*, apparently assisted by the movements of the buccal margin.

The *eye-spot* (*s*), so called, naturally comes under considera-

* As my views in regard to the relation of vibratile cilia to underlying cells may not be fully understood in this allusion, I would refer to my published opinion on this subject, in a note appended to some remarks upon *Actinophrys*, in the 'Proceedings of the Boston Society of Natural History' for September 1863, p. 283, and republished in the 'Annals and Magazine of Natural History' for November 1864.

tion in connexion with the tactile organ. It is a very minute circular body, apparently about as broad as the diameter of the *flagellum*, which lies a short distance behind the end of the head and just in front of the mouth (*m*). Frequently, from its excessive faintness and light-red colour, it appears to be absent; but, under careful scrutiny, it may always be detected. The tendency which prevails to undervalue the importance of this body, because it is present in an apparently similar position in the zoospores of Algæ, no doubt hinders our advancement in the knowledge of its true character and function. Whether it is an organ of vision of any grade, or even a sensorial centre of any kind, can only be brought within the range of probability. Its constant presence demands attention, and should excite inquiry on that ground alone; but when, moreover, we find it in a position which corresponds to that in which the chief sensorial centres are usually situated, no mere resemblance to something else should divert us into a train of fancies about the homologies of the red oil-globules of the zoospores of Algæ, whilst the main point at issue is left in obscurity.

If we cannot add anything further that is positive in regard to this organ, it will be well at least to attract attention to it in relation to its homologue in other Flagellata. In *Phacus pleuronectes*, Duj., it is not a uniform red spot, but seems to be divided into two regions, one of which is lunate in shape and of a bright red colour, and projects forward from the upper side of the other like an appendage; whilst the main part is more deeply seated in the dorsum, and consists of a colourless, but quite conspicuous, irregularly circular disk, about as broad as the contractile vesicle, which it partially overlies. In this case one might, with a fair show of reasonableness, suggest that the red portion alone is the true eye-spot, and that the colourless disk is a sensorial centre, not only for the former, but also for the flagellum, which arises close to it, on the ventral side. When we recall instances of the presence of a similar disk, which is unaccompanied by a red spot, in certain species of uniflagellate natant Flagellata (*Peranema*?, Duj.), and mark how long it is persistent after the body has fallen to pieces for the lack of fresh water, one cannot but feel that its superior consistency is a fair warrant for the belief that it is at least an important organ, and that, seeing the very faint colour of that of *Astasia trichophora*, the absence of all tint does not necessarily exclude it from the category of visual organs. On the other hand, it might be justly questioned whether even the deepest-coloured spots are at all sensitive to light; and the only answer would be that analogy renders it highly probable that they are.

The *mouth* (*m*) is a very marked feature when contrasted with that of other Flagellifers. It is usually to be observed in a closed state (fig. 46, *m*), when it may be recognized as a short, dark, sharply defined double line trending lengthwise with the body, and situated on the ventral side, a short distance behind the base of the *flagellum*, and just in front of the contractile vesicle. When open, it has a more or less broad oblong shape, and is more conspicuous than when closed. During the introception of food, it is quite active; but whether for the purpose of mastication, or merely to manœuvre the incoming particles, cannot be said positively, although it is probably with the latter design. The peculiar knobbed, particoloured aspect of the body is due to the almost invariably present large, highly refracting red and yellow granules in the general cavity.

The *contractile vesicle* (*cv*) is situated just behind the mouth, but near the dorsal side of the body. At full diastole it is globular, and its diameter is one-third of the breadth of the region in which it is situated. The systole is abrupt, and appears to be complete; and the diastole is slow, seeming to occupy all of the intervening time between the systoles. The rate of systole was not ascertained with sufficient accuracy to be recorded; but I should judge it to be not more than four or five times a minute.

The *reproductive organ* is probably represented by a very large, light, oval mass (*n*) which nearly fills the middle of the body. It has a decided outline, and, with the exception of a rather large central nucleiform body, its contents are homogeneous.

§ 13. Anisonema.

Anisonema concavum, nov. sp. Pl. VII. figs. 65–69.

Among all the heteronematous gubernaclifers, *Anisonema* possesses the highest degree of differentiation in its flagella (*fl*, *fl*²); for whilst in *Heteromita* and *Heteronema* these organs are comparatively more like each other, and arise from a nearly common point, as in the *Homoionemata*, in the former genus they exhibit a greater diversity of character, and also originate from more widely separated regions. These are particularly observable in the species before us now, and are certainly more valuable diagnostic characters than the presence of an uncontractile integument, by which to distinguish it from its congeners. The habitat of this animalcule is among tangled masses of confervoid *Algæ* in ponds and ditches, where decaying substances are most abundant. Upon these it moves with a more or less uneven pace, at one time gliding over a smooth

surface with scarcely a perceptible effort, and at another progressing with a laborious hitching gait, and lashing its *gubernaculum* (*fl*²) about, and swinging its body from side to side, with frequent jerks, in its efforts to pass over some obstacle.

The *body* is colourless and enclosed in an uncontractile, smooth integument. It has an asymmetrically ovate shape, rounded behind, and rapidly narrowed anteriorly into an oblique, truncate, conical front. Dorsally it is convex (figs. 67, 68); but ventrally, *i. e.* on the reptant side, it is concave on the right and in the middle, and so strongly incurved on the left that its sharp edge (*t*) reaches nearly to the median line. Beneath this inrolled border the enclosed space (fig. 68, *t*¹) projects into the left side like a longitudinal covered way. In front it is very deep, but from that point going backward it narrows gradually, and finally, with the inrolled edge, fades out at the posterior third of the body.

The *two flagella* (*fl*, *fl*²) are as widely diverse in character and function as any two similar organs in the whole group of Protozoa. The anterior one (*fl*) is, strictly speaking, the prehensile organ, as well as the main propulsory agent. It is quite delicate, and tapers gradually, from its subterminal base within the longitudinal covered way, to an extremely fine tip. In point of length it varies from one-half to two-thirds longer than the body. It is always carried in an extended position in front, and vibrates very actively, especially during reptation.

The posterior flagellar organ, or *gubernaculum* (*fl*²), is from three to four times the length of the body, and arises far from the front, in the deepest part of the covered way (fig. 68, *t*¹), and immediately beneath the contractile vesicle (*cv*). It is therefore attached quite near to the left margin of the body, and between the anterior and middle thirds. Its base, which is applied very obliquely to its point of attachment, is quite broad; but it narrows rapidly into a uniformly but scarcely tapering lash, which always projects forward more or less, and then curves backward and extends to a long distance behind. During reptation over smooth surfaces, it lies along the abdominal median line, and trails behind in long gentle undulations. Although it never vibrates, it frequently lashes about, and applies itself against obstacles on the right and left, or even in front, and acts as a prop upon which the body is thrown to one side or the other, according to varying circumstances. That it is contractile would seem incontestable upon observing the sudden jerk with which it sometimes draws the body back toward its distal end; but I am pretty well convinced, from a careful study of this movement, that, although this organ may be to a slight degree *resilient*, it is not

truly contractile, but rather *flexible*, and exhibits its muscular power by bending itself into coils or zigzags. Occasionally specimens are met with which have an additional pair of flagella (fig. 69, *fl*^{3}), of a more delicate kind, attached near the others. That these originate as a preliminary step to fissigemmation, although that phenomenon was not witnessed in this case, there can be scarcely a doubt, inasmuch as it accords perfectly with what has been observed in *Anthophysa* (p. 213).

The *mouth* has not been demonstrated to a certainty, by actually seeing food pass into it; but an approximative determination was reached by observing particles of matter, which were brought down by the prehensile *flagellum* (*fl*), pass into the body somewhere near the front, and apparently within the compass of the covered way.

The *anus* (figs. 65, 66, *a*) was adjudged to be at the posterior end of the animal, by noticing, in a couple of instances only, a clear, more or less irregular, rounded mass in this region, and its final disappearance while under observation; but the substance was so transparent that it was not possible to decide positively whether it made its exit upon the dorsal or the ventral side.

The *contractile vesicle* (*cv*) is a comparatively large organ, with a rounded contour when in full diastole, and quite faint and inconspicuous. It lies above the base of the *gubernaclum* (*fl*^{2}), the expanded base of the latter appearing at times to form a part of it, and by its movements (causing an alternation in light and shade) tends to mislead one into the belief that systole is very irregular. A careful adjustment of the lens, however, reveals the true pulsation, and shows that the systole has a very slow rate.

§ 14. Heteromastix, Jas.-Clk.*

Heteromastix proteiformis, Jas.-Clk. Pl. VII. figs. 70–74.

I shall not describe this infusorian in the same systematic manner that has been adopted in treating of previous genera, because I do not know much about its internal organization; but in order that the direct alliance of the Flagellata with the Ciliata may be illustrated in this memoir in its strongest light, and inasmuch as *Heteromastix* is by far the best example of such a transition between the two above-mentioned orders, I shall take the liberty of quoting what I have already published in regard to it in another place†.

"Here is an infusorian (figs. 70–74), from fresh water,

* ἕτερος, dissimilar; μάστιξ, a lash. This genus was originally described in my published volume of Lowell Lectures, 'Mind in Nature,' p. 146, fig. 88.

† See note *.

which, although it has a pretty strong resemblance to *Euglena*, heightened by the presence of a red eye-spot (*s*), will be found upon investigation to possess some additional and decidedly different characters. In the first place, it has two vibrating lashes (fl, fl^2), which differ remarkably among themselves both in position and character. One of them is always carried in front, like a sort of proboscis (fl); and in fact it seems to have the office of such an organ, like that of an elephant, to feel and to take hold of objects. I must confess that I was struck with astonishment at the apparent intelligence with which the infusorian extended, and twisted, and turned, and felt about with this extraordinary organ. Never did an elephant seem to use his trunk with more thoughtfulness. With like control did the animal also use the other lash (fl^2), always keeping it turned back along the body, so that it formed a kind of moveable keel when the little creature glided along in its watery element, or was used to sway it from side to side, or oftentimes to raise it up on its tail by forming a prop, as we see it in this other figure (fig. 73).

"The motory or propelling power, on the other hand, is restricted, at least in the greatest measure, to another kind of vibratile cilia. These are very short, and are crowded together in great numbers (*cl*) in a broad furrow or depression (f) which extends over half the length of the body, along its inferior middle line. When the body is turned over, and the anterior end retracted and swelled out sideways, the furrow (fig. 73, f) becomes quite conspicuous, and the extent of the group of minor cilia (*cl*) is easily ascertained. They are very minute, and in constant motion, propelling the body backward and forward, up and down, to the right or left, according as it is steered by the trailing lash (fl^2) which extends along its length. Thus it is that, although similar in form, a diversity of functions is laid upon these three kinds of cilia that amounts to the most marked specialization, through the simplest means —in fact so simple that the eye cannot detect them in any form besides that of proportion and position, and certainly not in the intimate structure of these bodies. The whole body, too, possesses a flexibility and extensibility scarcely inferior to its cilia: at one moment it is darting through the water, sharp as a lance at both ends; and at the next it is as round as a ball, or worming its way through tortuous passages with every possible degree of flexure short of actually tying itself into a knot."

It would be difficult to say now whether *Heteromastix* belongs to the Flagellata rather than to the Ciliata, or *vice versâ*. The structure, position, and peculiar mode of action of its fla-

gella recall *Anisonema* (§ 13) most vividly to mind; but, on the other hand, the group of cilia (*cl*) in the obliquely longitudinal furrow (*f*) in close proximity to, and evidently acting more or less as allies with, the flagella (*fl*, *fl*^{2}), find their parallel in the "proboscis-like lash" (fig. 75, *fl*) and vestibular cilia (*cl*) in the oblique buccal furrow of *Pleuronema* (§ 16) and *Dysteria* (§ 15). How closely allied the two latter are to the former is not the immediate question here; it is, are they related at all? We think there can be no hesitation in replying in the affirmative; but in order that the reader may have the proof before his eyes, I think it will not be out of place, in this memoir, to introduce some of the undoubted Ciliata which possess at the same time organs that are as truly flagellate in character as are the flagella of *Anisonema*, *Astasia*, &c. The genus *Dysteria* shall be our first example.

§ 15. Dysteria, Huxley.

Dysteria prorœfrons, Jas.-Clk.* Pl. VII. figs. 77, 78.

This species "is an infusorian between two leaves or flexible shells (*v*, *v*^{1}) of unequal width, which are united by a sort of hinge along the left border, and gaping to a more than equal extent along the right side, where the upper one (*v*) far overhangs the other (*v*^{1}, *bk*) throughout the whole length of its free edge. The broader or dorsal shell (*v*) is convex towards the eye, and the whole organization lies within its concavity, whilst the narrower one (*bk*, *v*^{1}) is flat, simply covering the body, and as a natural consequence does not include any part of it. The open space between them is endowed with a row of closely set, large vibratile cilia (*cl*), which differ in size according to their position, those in front being by far the longest, and those along the side scarcely more than half as long; and, in addition, there is one (*fl*) which, from its great size, has more of the character of a proboscis or prehensory flagellum, and is attached nearly at the extreme anterior border of the row (*cl*).

"It is not an easy matter in this case to determine how much of the one-sided, cilia-bordered furrow corresponds to the disk or vestibule of *Epistylis*, *Stentor*, *Paramecium*, or *Pleuronema*; nor does it affect the question of the degree of obliquity of the conformation of this animal, so long as we see that, whatever it may be, either wholly or in part a vestibule, it is at least extremely oblique, and that it is not possible to view it from any point but that the body appears asymmetrical in relation to it.

* See 'Mind in Nature,' *ut supr.* p. 171, fig. 100.

"The most striking peculiarity of this creature is its habit of swinging around on a pivot (*fl*²), which consists of an ovate or lancet-shaped appendage, of considerable dimensions, that projects from near the posterior end of the body, and in the line of the row of cilia. The pivot possesses perfect flexibility at its base, so that the animal can move over a considerable distance backward and forward without disturbing the point. Most of the time it keeps the flat side down when gyrating around its place of attachment; but now and then it turns upon its right edge, and performs its eccentric rotations about the appendage. This is the habit which, as I said before, has impressed some observers with its similarity to the Rotifera. In connexion with this, too, it happens that the creature possesses a pair of jaw-like or, rather, pincer-like bodies (*m*¹), which lie near the entrance to the mouth, and occasionally open and shut like a pair of forceps, just as similar bodies known as the jaws of Rotifers do, whilst food is passing between them. Excepting the passage between these jaws, there is not the least trace of an intestine, or of any definite cavity devoted to digestion. The food occupies the whole length and breadth of the body, under the same circumstances as are observable in *Paramecium*, *Pleuronema*, *Stentor*, &c.

"The contractile vesicles are two (*cv*,*cv*) quite small globular bodies, one of which is situated just to the right of the jaws (*m*¹), and the other close to the base of the pivot (*fl*²); and, although they contract very slowly (not oftener than once in four or five minutes), they evince every characteristic, in action and physiognomy, of true infusorian pulsating vesicles. The large colourless reproductive organ (*n*) singularly exemplifies in itself the one-sidedness of the animal, by its conformation to the shape of the body. One side of it is convex, and, like the rest of the organization, projects into the concavity of the larger shell, whilst the other face is flat and, as it were, moulded upon the plane shell. It forms a very conspicuous object just to the left of the jaws, and might easily be mistaken at first glance for a contractile vesicle, especially as the true representatives of that organ are so very inconspicuous both in regard to their size and actions.

"Now in all the organization of this animal there is nothing which is not strictly infusorian in character. The jaw-like bodies (*m*¹) are not confined to this alone; for there are quite a number of others which possess a similar apparatus at or near the mouth. *Chilodon* has a complete circle of straight rods around the mouth. As for the pivot (*fl*²), it is nothing but a kind of stem, such as exists on a larger scale in *Stentor*, or is more peculiarly specialized in the pedestals of *Epistylis*, *Zootham-*

nium, or *Podophrya*; and, as counter to what we see in these last, I would state that there are certain of the Vorticellians, closely related to *Epistylis*, which have no stem whatever, and swim about as freely as *Dysteria*."

§ 16. Pleuronema, Duj.

*Pleuronema instabile**, Jas.-Clk. Pl. VII. figs. 75, 76.

This infusorian bears such a strong resemblance to *Heteromastix* (§ 14) in some of its external features, that it seems as if it might more properly have succeeded the latter in the illustration of my subject; but mere resemblances do not always indicate relationship: and in the case of *Pleuronema*, in particular, this is most true; for it is decidedly a far more highly organized animalcule than *Dysteria*, as we shall see by what I shall now quote from an already published description †:—

"What I wish now to show in the *Pleuronema* is the triple, or, I might say, even the quadruple diversity of the vibrating cilia, or, in other words, a quadruple specialization of one type of organs, by their manifold offices ranking their possessors above those of their class which attain to a less degree of complexity in this respect. The most prominent of these cilia are those (fig. 75, cl^1) which are arranged in longitudinal rows over nearly the whole extent of the body, and which most frequently are seen in a quiet state, projecting far out from the surface, like so many fine rigid bristles. In fact the motions of this animal are so lightning-like in rapidity, that I have never seen this form of cilia except when the body was in a quiet state; and therefore I judge that, as they do not move then, they are the principal organs of locomotion. There is on the right side a group of much more heavily built cilia (*cl*), which project from the oblique furrow in which the mouth (*m*) is set. They are more particularly devoted to producing currents in which the particles of food may be brought to the mouth.

"We see, also, projecting from the forward end of the oblique furrow, and near the anterior edge of the mouth (*m*), one of those proboscis-like lashes (*fl*) [a *flagellum*] which are so characteristic of the lower ciliate [flagellate] infusoria; but yet it would not seem to have the same office as in the latter, since it is usually held in this position, apparently as rigid as if it were a wire; and only now and then does it move, by a sudden jerk, and disappears in the oblique furrow—probably acting there in concert with the other cilia in the introduction of food into the mouth. The fourth and last kind of cilia of

* See 'Mind in Nature,' *ut supr.* p. 148, fig. 90. † See note *.

which I have to speak consists of two excessively faint, very long, and quite large, bristle-like filaments (sl, sl^1), which project from each end of the body. The straight one (sl) always precedes when the creature is in motion; and the curved one (sl^1) is attached a little to the left of the posterior end of the body. Both are always rigid when the animal is not in motion, but yet there can be no doubt that they are flexible; for at times they disappear suddenly, and probably are bent under the body. What their office is I cannot say, but conjecture, from their resemblance to what are called the saltatory bristles of other infusorians, that they are used as accessory means of sudden propulsion or leaping—a habit which seems to be the most frequent mode of leaving any point at which the creature has fairly come to a standstill.

"The contractile vesicle (cv) lies close to the forward end of the body, and corresponds in activity to the vivacity of the motions of the latter. It contracts every ten seconds, and with more vigour than any other that I know of. It is very conspicuous, as it is two-thirds of the time in an expanded state; and it disappears and reappears like the sudden closing and opening of a large eye.

"I have already indicated the position of the mouth (m) as being near the broader, anterior end of the oblique furrow, but again speak of it here in order to make the description of the digestive system complete. From the mouth (m) the food passes directly into the general cavity without going through any throat, and most frequently combines in large masses (d).

"The presence of a reproductive organ (n), which we find here in the form of a clear, colourless, globular body, when added to all the other systems which I have mentioned, puts this animal in the condition of a fully organized ciliated infusorian, and would seem to give us full warrant for believing it to be the culmination of a progressive development whose tendency is to pass through such forms of animate organization as we have just been tracing in the successively more and more complicated creatures whose images are before us."

EXPLANATION OF PLATES V., VI., & VII.

The corresponding parts in the figures are lettered alike, excepting when otherwise stated in the description of any particular illustration.

a, anus: b, membranous collar; b^1, edge of b; b^2, base of b: bk, the beaks of the valve of *Dysteria*: c, calyx; c^1, aperture of c; c^2, lower half of c: cl, cl^1, vibratile cilia: cv, contractile vesicle: d, digestive vacuole, or ingested food: e, furrow in fissigemmation; e^1, anterior end of e; e^2, prolongation of e, e^1: f, broad sulcus (in *Heteromastix*): fl, flagellum;

fl[1] minor flagellum; *fl*[2], *gubernaculum*: *fr*, frontal area: *i*, neck or anterior half of body: *lp*, lip: *m*, mouth; *m*[1], jaws: *md*, monads of the Sponge, &c.: *n*, reproductive organ: *o*, ostioles: *pd*, pedicel; *pd*[1], top of *pd*; *pd*[2], forks of *pd*: *r*, retractor muscle; *r*[1], furrow in which *r* is imbedded and attached: *s*, eye-spot: *sl*, *sl*[1], saltatory cilia: *sp*, triradiate spicula; *sp*[1], aciculate spicula: *t*, margin of the inrolled side of *Anisonema*; *t*[1], the deep furrow or covered way behind *t*: *v*, broader valve of *Dysteria*; *v*[1], the narrower valve.

Figs. 1–4. *Monas termo*, Ehr.?. Fig. 1, a group of free monads, 500 diam. Fig. 2, a free monad seen from the narrower side, with the lip (*lp*) next the observer, and the contractile vesicle (*cv*) in profile, 950 diam. Fig. 3, an attached form seen from the broad side, 1200 diam. Fig. 4, a free monad in the act of swallowing a large morsel of food, 950 diam.

Figs. 5, 5[a], 5[b], 6. *Monas neglecta*, n. sp. Fig. 5, broad-side view of a pedicellated monad, 950 diam. Fig. 5[a], a posterior view, showing the axial attachment of the pedicel (*pd*[1]) and the contractile vesicle (*cv*) in profile, and the flagellum (*fl*) in the distance, 950 diam. Fig. 5[b], a free monad in the act of swimming, 950 diam. Fig. 6, an attached form, contorted in the act of swallowing a large morsel of food, 950 diam.

Figs. 7–27. *Codosiga pulcherrima*, n. sp. Fig. 7, a colony of eight monads, drawn within an hour after the fissigemmation of three of its members, 150 diam. Fig. 8, a group of five, in a bird's-eye view, 500 diam. Fig. 9, a single monad with three contractile vesicles (*cv*), the dotted lines indicate the degree of the lateral vibratile expansion of the membranous collar (*b*), 950 diam. Fig. 10, the same as fig. 9, preparing to undergo fissigemmation; the body is contracted and widened, and the collar (*b*) broadened. Figs. 11–22, to illustrate the process of *fissigemmation*, 750 diam.; for particulars see the text (pp. 196–199). Fig. 23, a free monad in the act of swimming, the vibrating flagellum (*fl*) acting as a propulsory agent and following in the rear, 950 diam. Fig. 24, a single pedicellated monad from old, stale water, the membranous collar (*b*) contracted into a cone, and the flagellum (*fl*) vibrating rapidly, 950 diam. Fig. 24[a], a very large pedicellated form, just before *fissigemmation* begins, the body partially contracted, and the collar (*b*) vibrating; the peculiar sigmoid curve of the flagellum (*fl*) is well shown here, 950 diam., —figs. 25, 26, 27, showing the different degrees of contraction of the membranous collar (*b*) of the same individual: in fig. 25 the *flagellum* (*fl*) is vibrating rapidly, just at the moment when the collar (*b*) has returned to its usual form and attitude, 750 diam.

Figs. 28–32[a]. *Salpingœca marina*, n. sp. Figs. 28, 29, 30, the same individual in different states of expansion, 1900 diam. Fig. 31, the body completely filling the calyx, so that the latter is scarcely distinguishable except at its mouth (*c*[1]), 1900 diam. Fig. 32, showing the calyx as a distinct envelope considerably separated from the body at the bottom (*c*) and at the aperture (*c*[1]), 1900 diam. Fig. 32[a], an empty calyx closed, 1900 diam.

Figs. 33, 33[a], 33[b], 33[c]. *Bicosœca lacustris*, n. sp. Fig. 33, an adult with the lip (*lp*) nearest the eye, the flagellum (*fl*) in the background, and the longitudinal furrow seen through the body. The flagellum (*fl*) is uncoiling just as the body emerges from the bottom of the calyx (*c*), 950 diam. Fig. 33[a], a young

animal in profile, showing the peculiar attitude and curve of the flagellum (*fl*), the narrow aperture (c^1) of the calyx (*c*), and the unilateral attachment of the retractor muscle (*r*); the pedicel (*pd*) is just beginning to develope, 950 diam. Fig. 33^b, a young form partially emerged from the bottom of the calyx (*c*), the latter contracted at the mouth (c^1) and the flagellum (*fl*) forcing its way through, as is usual, in a loop, 950 diam. Fig. 33^c, the same as fig. 33^a, retracted to the bottom of the calyx (*c*) and the aperture (c^1) of the latter nearly closed, 950 diam.

Figs. 34, 35. *Bicosœca gracilipes*, n. sp. Fig. 34, the longitudinal furrow (r^1) and the flagellum (*fl*) next the eye, the lip (*lp*) in the background, 1900 diam. Fig. 35, the body retracted to the bottom of the calyx (*c*) and the flagellum beginning to uncoil, 950 diam.

Fig. 36. *Codonœca costata*, n. sp. The body seated in the bottom of the pedicellated calyx (*c*), 950 diam.

Figs. 37, 37^a, 37^b, 37^c, 37^d. *Salpingœca amphoridium*, n. sp.: all magnified 950 diameters. Fig. 37, an individual suspended freely in its calyx (*c*, c^1). The dotted lines indicate the attitude which the collar (*b*) assumed for a while during the observation upon this specimen. A particle of fæcal matter has just left the anus (*a*). Fig. 37^a, the lower part of the calyx filled by the body, the upper part (c^1) free from the neck (*i*) of the animal, and the membranous collar unusually narrowed. Fig. 37^b, the calyx mostly filled by the body, the head (*i*) bent to one side, and the flagellum (*fl*) in the act of expelling a particle of undesirable matter. Fig. 37^c, an empty calyx, slightly contracted in dimensions. Fig. 37^d, the body contracted and filling the calyx, and the membranous collar (*b*) partially retracted.

Figs. 38, 39. *Salpingœca gracilis*, n. sp., 950 diam. Fig. 38, the body retracted within the calyx (*c*, c^1). Fig. 39, the same as fig. 38, partially protruded from the calyx.

Figs. 40–44. *Leucosolenia* (*Grantia*) *botryoides*, Bowrbk. Fig. 40, a colony of sponge, natural size. Fig. 41, view of a profile section of the monadigerous layer, the monads (*md*) closely packed together, side by side, with the membranous collar (*b*) and the flagellum (*fl*) projecting into the general cavity of the colony, 95 diam. Figs. 42, 43, 44, isolated monads with the membranous collar (*b*) in various attitudes, 950 diam. See also fig. 64.

Figs. 45, 46. *Astasia trichophora*, Clap. Fig. 45, a dorsal view, the mouth seen through the head, and the *gubernaculum* (fl^2) in the background, 500 diam. Fig. 46, the body in an amœboid, contorted state, 500 diam.

Figs. 47–63. *Anthophysa Mülleri*, Bory. Fig. 47, a colony of adults attached to a single tubular branchlet or pedicel (*pd*); one of the monads is in the act of passing a morsel into its mouth (*m*), 950 diam. Fig. 48, a pair of adults seen in profile, 950 diam. Fig. 49, a pair of young monads, one in profile and the other presenting its narrow side, 950 diam. Figs. 50 & 51, different attitudes of the same monad as the one in profile in fig. 49, during the introception of food, 950 diam. Figs. 52–61, to illustrate the process of fissigemmation, 950 diam. Fig. 62, a piece of a tubular branchlet like fig. 47 (*pd*), 1900 diam. Fig. 63, a piece of a flat branch from an old part of the colony, 950 diam.

Fig. 64. *Leucosolenia botryoides*, Bowerbk. A portion of the monadigerous layer (*md*) seen through the spiculiferous stratum, with the spicula next the eye, 500 diam.

Figs. 65–69. *Anisonema concavum*, n. sp.: all magnified 500 diameters. Fig. 65, a dorsal view, the inrolled margin (*t*) seen through the body. Fig. 66, a ventral view of fig. 65, the base of the gubernaclum (fl^2) covered by the inrolled edge (*t*). Fig. 67, a profile view of the right side of the body, showing its concavo-convex character. Fig. 68, an end view to show the lateral extent of the covered way from which the *gubernaclum* (fl^2) and the anterior flagellum (fl) spring. Fig. 69, a ventral view of an animal which possesses two extra flagella (fl^3). It is probably in the incipient stage of fissigemmation.

Figs. 70–74. *Heteromastix proteiformis*, Jas.-Clk. All the figures are magnified 500 diameters. Fig. 70, profile view of the right side of a fully extended animal, the gubernaclum (fl^2) trailing beneath. Fig. 71, the same as fig. 70, in a partially contracted state. Fig. 72, an individual seen directly from below, with its anterior end strongly retracted and broadened. Fig. 73, an animal partially contracted and propped up on its tail by its flagella (fl, fl^2), and exposing its ventral ciliated furrow (*f*) to full view. Fig. 74, an end view of the head, with the group of cilia (*cl*) on the lower side.

Figs. 75, 76. *Pleuronema instabile*, Jas.-Clk. Fig. 75, a dorsal (ventral, homologically speaking) view, 1000 diam. Fig. 76, an end view of the head; the contractile vesicle (*cv*) in the foreground, and the flagellum (fl) in the distance; a part of the ventral side is destitute of cilia: 500 diam.

Figs. 77, 78. *Dysteria prorœfrons*, Jas.-Clk. Fig. 77, a view of the dorsal (homologically the ventral) side, the broader valve (*v*) next the eye, and the narrower three-beaked valve (v^1, *bk*) in the extreme distance, 600 diam. Fig. 78, a foreshortened view of the body as it appears when turned up on its right edge; the head next the observer, and the pivot (fl^2) in the distance: 600 diam.

XXXIV.—*Description of two new Gobioid Fishes from Sarawak.* By Dr. A. Günther, F.R.S., F.Z.S.

[Plate XII.]

The Marquis J. Doria has sent to the British Museum a collection of Fishes made by him in Sarawak (Borneo). Several of the species are new to the fauna of Borneo*, viz. *Nemachilus fasciatus* (K. & v. H.), *Apocryptes viridis* (H.B.)†, *Exocœtus oligolepis* (Blkr.), *Caranx atropus* (Schn.), *Dussumieria acuta* (C. & V.), *Pristigaster macrognathus* (Blkr.), *Saurida argyrophanes* (Richards.). *Eleotris melanostigma* (Blkr.) is not specifically distinct from *E. butis* (H. B.), a species ranging from the east coast of Africa to Borneo and China. The total number of species known from Borneo

* See Bleeker, "Dertiende Bydrage tot de Kennis der Visch-fauna van Borneo," in Act. Soc. Sc. Indo-Neerl. 1860.

† This is not a *Boleophthalmus*, to which genus it has been referred by all previous authors.